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MEMORANDUM TO: Chairman, Research, Development, and Production Review Board

FROM: Chief, Engineering Division, OC

SUBJECT: High-Speed Communications System, 25X1

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1. THE PROBLEM

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In contract with the Los Angeles, California, we have developed transmitting and receiving equipment designed for point-to-point communication and capable of continuous operation at the rate of 1600 words per minute. In order to obtain the full benefit of this equipment operating as a high-speed system, it is mandatory that the processing of intelligence at the transmitting and receiving sites be handled at speeds compatible to that at which the transmission may be accomplished. The equipment necessary for high-speed processing (cryptographic and page-printing or reperforating devices) exist at the present time, but not in a form applicable to the system.

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2. FACTS BEARING ON THE PROBLEM

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2.1. has delivered a complete prototype one-way high-speed system capable of point-to-point transmission at the rate of 1600 words per minute over a range of 5000 miles. This system has recently been given a successful engineering evaluation, and has been found to be satisfactory.

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2.2. The existing receiving equipment records magnetically in digital form the intelligence received. The intelligence is then reprocessed at a rate of 60 words per minute through normal teletype reperforators and/or page-printers. At this processing rate, five to six hours will be required to process the traffic received during a fifteen-minute transmission. See attached terminal drawings. 25X1

2.3. Through the use of high-speed electronic cryptographic equipment, probably operating on line, and high-speed page-printing and/or reperforating equipment, it is entirely feasible that the equipment presently in existence may form the basis of a high-speed automatic point-to-point communications system. This system would transmit from clear punched tape to clear punched tape or printed word over a 5000 mile path at the rate of 1600 words per minute and be completely automatic. The page-printing, reperforating, and basic cryptographic 25X1

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25 YEAR RE-REVIEW

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equipments required for this operation have been developed. They require only minor modification and applique work to make them operable with the [redacted] equipment. 25X1

2.4. Due to the automatic feature of this equipment, it will be capable of handling huge volumes of traffic with an absolute minimum of personnel. Thus at the disposal of the planners is a technique perhaps capable of answering the emergency or standby communications problem. Both transmitting and receiving portions of this system are ten-channel autotuned, and as such would be capable of shifting frequencies with extreme rapidity. This may suggest an operational technique creating the capability of avoiding jammers for very short periods and moving important traffic at high speeds during these seconds when the jammer is trying to catch up. Here is a system offering the capability of storing traffic during periods of disturbed atmospheric conditions and then moving six hours of normal speed traffic in fifteen minutes of usable ionosphere.

2.5. Recent developments in the page printer field indicate that the state of the art is such that very high speed printing is entirely feasible. Several companies are known to have developed high-speed printers.

2.5.1. The Burroughs Corporation subsidiary, Control Instrument Company, Brooklyn, New York, has developed a machine capable of printing at the rate of 8600 words per minute. Printing is accomplished through wire generation of dot patterns on a matrix. The printed characters are effectively transmitted through multiple copy paper forms so that as many as nine carbon copies are possible. At the rate of 900 lines per minute and 48 characters per line, it is obvious that the printing speed is far beyond that necessary for direct printing of [redacted] on line. 25X1

2.5.2. The Analex Corporation, Concord, New Hampshire, has developed what they call a syncro-printer which will print 15 lines per second, with 40 or more characters per line. At 40 characters per line, this is a rate of 7200 words per minute. This device consists of a motor-driven

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print roll revolving at 30 RPS. The print wheel contains the alphabet and numerals around the drum with a complete set across the drum for each of the 40 characters per line. As the wheel rotates, sync pulses are fed into an electronic storage for character identification. When one character coming into the storage matches the sync pulse for the desired character in the proper position on the line, a thyrotron firing circuit causes the printing hammer corresponding to that position to imprint the character on the paper.

2.5.3. The Potter Instrument Company, Great Neck, New York, has recently announced the manufacture of a "Flying Typewriter," which has a printing speed of 7 1/2 lines per second with 80 or more characters per line. This represents a rate of 7200 words per minute. The price per unit for the Analex page printer or the Potter "Flying Typewriter" is in the neighborhood of $50,000.00.

2.6. The Teletype Corporation is presently developing a high-speed reperforator reported to be capable of operation at 1600 words per minute or better. It is presently intended that this development will be in production in about sixteen months. The application of high-speed reperforating equipment to this system would provide for the rapid relay of intelligence through normal teletype channels, through additional channels, or through other systems. In addition, the Teletype Corporation is planning to introduce a complete line of equipment operating in the range of 600 words per minute in the near future. It is entirely feasible that two or three of the 600 WPM printers may be used in conjunction with a high-speed reperforator for processing the traffic.

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2.7. The direct page-printing of enciphered text would still require a relatively slow laborious deciphering process. For this reason, the companion equipment to the page-printer would logically be a high-speed cryptographic system, probably operating on line.

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2.7.1. Discussions between technical personnel from NSA, and CIA indicate that

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the key generator from the NSA 503 system presently in production will be rather easily adaptable to on-line cryptographic operation with the system. The major problem will be that of synchronization. After a synchronized start, a shut-down of the equipment for more than one hour will probably necessitate a new synchronized start. However, during the operating period and within one hour after shut-down, it is the opinion of the engineer that the frequency standards incorporated in the system would maintain sufficient accuracy to facilitate the necessary synchronization of these systems. NSA personnel indicate that they will be happy to furnish technical information and monitor this project from both a technical and a security viewpoint. In addition, when the applique equipment is ready for evaluation, NSA will lend this Agency the necessary 503 key generators in order to facilitate field testing of this equipment. NSA has requested at least a month's notice, however, prior to the period the two 503 equipments will be required.

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2.7.2. The National Security Agency is presently negotiating a contract for the production of service test models of the 503 systems and if CIA intends to procure this equipment within the next two years, it will be necessary to place an order by May 1956 so that this order may be included in the present contract. A new sub-miniature model is in the development phase and will be available in about three years. The sub-miniature model consists of a 19-inch rack-mounted drawer, whereas the present 503 model consists of a full rack, including five drawers of equipment. The cost of the present model is $15,000.00 each, including spares. There will be two equipments required for each base station installation.

3. DISCUSSION

3.1. The basic principle of operation of the system centers upon the use of standard 5-baud teletype code. Each teletype baud is assigned a separate channel

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which operates at a specific frequency and which is spaced 2.6 kc from adjacent channels. The channels are pulsed successively in a fixed time sequency by pulses 1.25 milliseconds in width. The information associated with a given teletype baud is denoted by the presence or absence of a pulse at the proper time in the pulse sequence. Character formation is thus attained by controlling the occurance of pulses, at successive pulse positions of the five channels, in accordance with the standard 5-baud teletype code. Modulation accomplished by the time-sequential pulsing of a multichannel system has been termed Quantized Frequency Modulation.

3.2. This system may be visualized to commence at the transmitting end with a reel loaded with conventional 5-baud perforated tape. The normal size reel is capable of

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operating the transmitter for about 15 minutes. This would enable the station to transmit the equivalent of approximately six hours of normal speed traffic. At the time representing the most ideal propagation conditions, or at a pre-arranged period during each hour or day, it is simply necessary for the operator to press the button starting the tape transport. The intelligence would then be electronically read from the

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tape, enciphered on line, and applied through the exciter to modulate a high-powered transmitter. See Figure 1. The first fraction of a second of the transmission would consist of a recognition signal, capable of triggering the receiver and starting the operation of the receiving station.

3.3. The receiving station some 5000 miles distant would be in a stand-by condition. This requires only that the receivers be set at the proper frequency and operating. The receiving equipment need not be monitored or attended by personnel at any time during the operation. Upon receiving the recognition signal, the remainder of the equipment at the receiving site would start automatically and the following action would take place. The intelligence would be automatically integrated and read from the five channels. It would then be converted to a digital signal, deciphered, and converted to the necessary pulses to operate high-speed page printers or reperforators. See Figure 2. Without the need for attendance of any sort, the receiver would continue in operation until the transmitter had reached the end of its transmission, at which time it would stop and return to the standby position to await the next transmission. At the receiving station the output would be either a perforated tape or printed page containing the entire six hours of normal speed traffic, approximately fifteen minutes after the beginning of the

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transmission. It should be noted that both the transmitter and receiver of the system may be operated with a self-contained VFO or as a 10-channel autotuned system capable of shifting frequency channels within seconds.

3.4. Through the use of this system huge quantities of traffic may be handled during a normal working day with very few operating personnel. On the other hand, it would be possible to accumulate a day's normal speed traffic and transmit the entire accumulation over a fifteen or thirty-minute period when propagation conditions are most ideal. If the use of slow speed processing techniques were contemplated, it would be necessary to greatly increase the number of operating personnel in order to keep up with the capabilities of this equipment.

3.5. The alternative to this program; that is, the slow-speed processing of received intelligence from would require many processing units consisting of equipment and personnel to enable the receiving station to turn received intelligence into printed copy with the rapidity necessary to match the speed of the system. In order to process at slow speed an hour of transmission, it would be necessary to have four complete processing units working for about six hours. This assumes that the processing equipment being utilized is standard 60 word per minute. If the equipment is utilized for traffic for two hours, then in order to process the traffic received during this period, eight processing units would be required, and so on. This alternate solution to the problem would appear to be rather impractical, and would definitely require additional personnel. This would certainly eliminate one of the great advantages of the automatic high-speed equipment.

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4. CONCLUSIONS

From the foregoing discussion the following conclusions may be derived:

4.1. Regardless of the operational use contemplated, it would appear that the addition of the high-speed message processing equipment is a very desirable feature to convert this high-speed transmitting and receiving equipment into an automatic, reliable high-speed system of communications.

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4.2. Since the additional equipment presently available is not directly applicable to the [redacted] system, a development program will be required. This program should include the purchase of high-speed cryptographic, page-printing, and/or reperforating equipment. In addition, the development of applique circuitry to make this equipment operable in the [redacted] system will be necessary.

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4.3. The program for the applique development should commence at the earliest possible date in order to have the equipment available soon after the production of [redacted] commences. The present existence of high-speed printing and cryptographic equipment, along with appliques for their use with different systems, indicates that this program is entirely feasible and may be undertaken with a certainty that successful completion may be accomplished in a relatively short time.

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4.4. The following are estimates of the cost and time required for this project:

4.4.1. The cost of one prototype page-printer for this application will be approximately $50,000.00.

4.4.2. The cost of one 503 cryptographic system for this application will be approximately $30,000.00 for each complete system.

4.4.3. The cost of developing the applique circuitry for the utilization of these equipments with the [redacted] system will be approximately $50,000.00 - $100,000.00.

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4.4.4. The time required for the development of the applique circuitry in order to adapt the cryptographic equipment and the high-speed page-printing and/or reperforating equipment to this system will be approximately nine months.

5. ACTION RECOMMENDED

5.1. It is recommended that the Engineering Division be directed to determine the most desirable equipment applicable to this system and to contract for the

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design and fabrication of one complete automatic processing system to include high-speed OFF LINE AND on-line encipherment, decipherment, and printing and/or reperforating.

5.2. It is further recommended that the National Security Agency be requested to supply technical specifications, drawings, and other necessary information for the application of the appropriate 503 cryptographic equipment to the [redacted] system. It is also recommended that, upon determination of the number of [redacted] systems to be procured, a comparable number of appropriate 503 equipments be requisitioned from the National Security Agency. In order to procure this equipment in a reasonable time, it will be necessary to have this Agency's requirements included in the existing NSA production contract.

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Attachments:

(1) Figure 1

(2) Figure 2

(3) Transmitting Terminal

(4) Receiving Terminal

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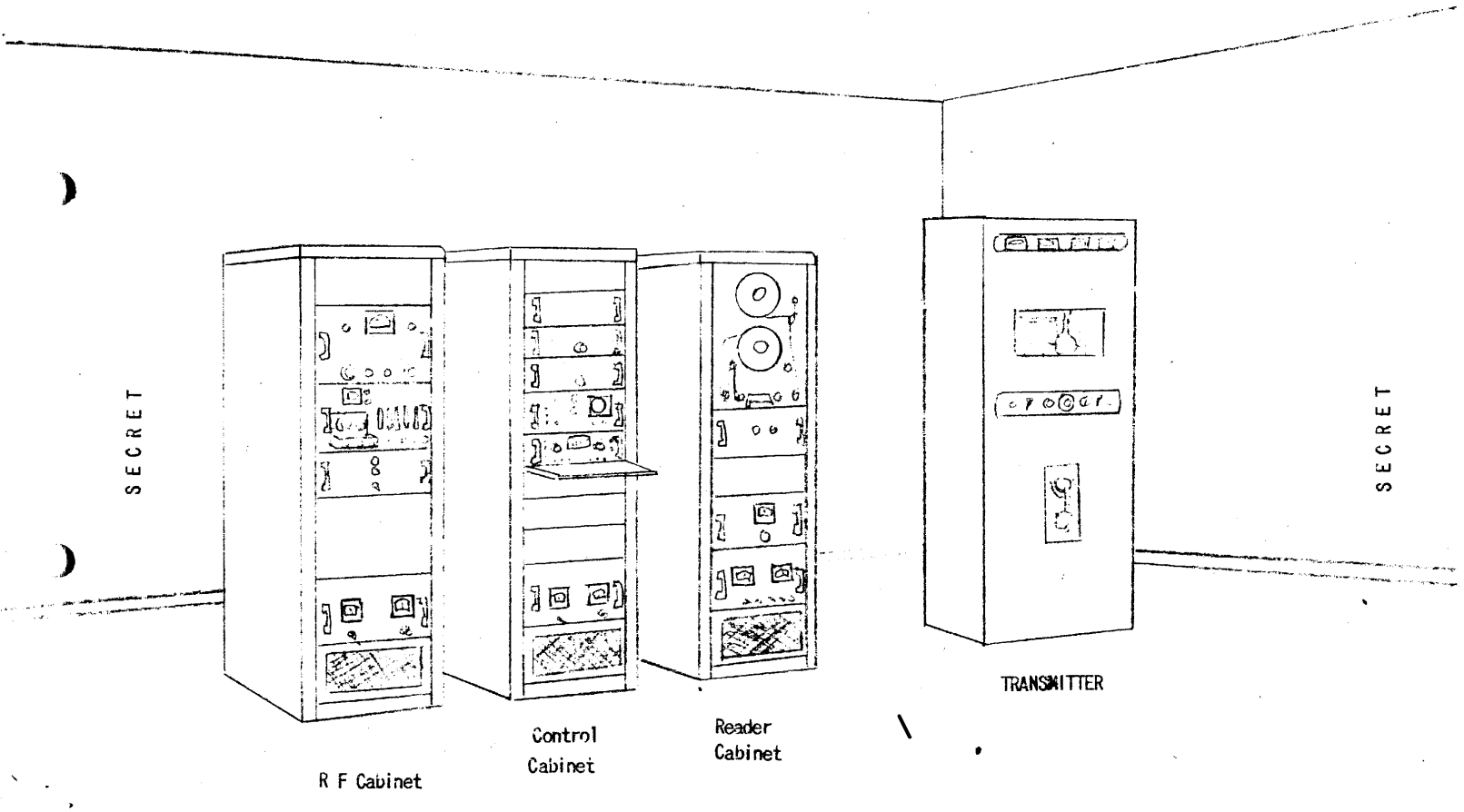

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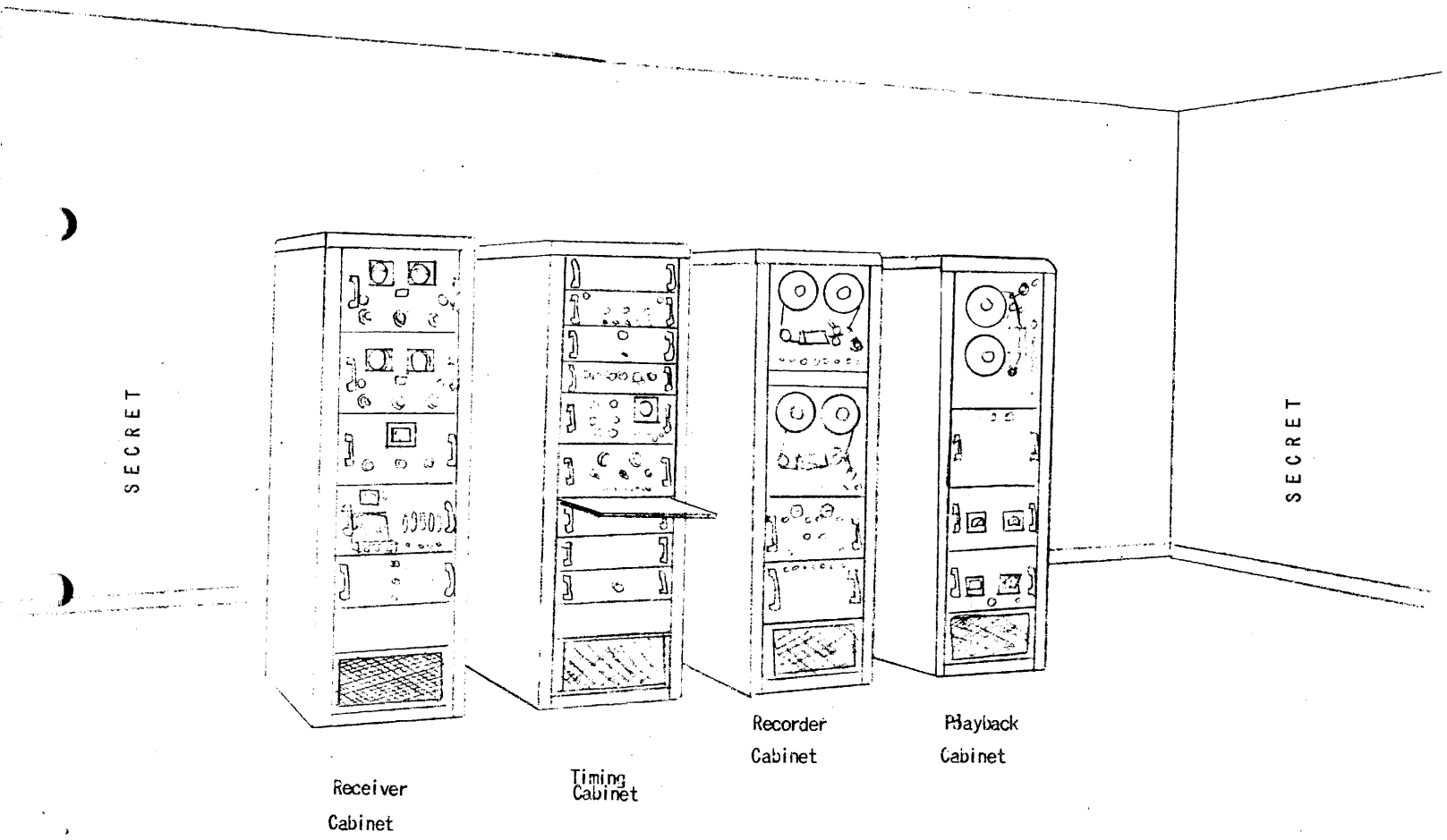

RECEIVING TERMINAL

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